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Original Research Article

Application of non-operative management protocol in pediatric blunt splenic injuries with other associated injuries

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ABSTRACT

Background: Non-operative management (NOM) has become the standard of care for isolated blunt splenic injuries with satisfactory success rates. However, literature is scarce about the non-operative management of blunt splenic injuries (BSI) with other associated injuries (OAI). The main aim of this study is to assess the applicability of protocol-based NOM in BSI with OAI.
Methods: Protocol based resuscitative algorithm was followed for the management of patients with BSI and OAI. NOM was taken up in those patients who were hemodynamically stable and was not attempted in patients who remained hemodynamically unstable or developed hemodynamic instability even after the resuscitative efforts. The data was collected and analyzed.
Results: Forty patients with the mean age of 7.05±3.9 years were studied. Fall from height formed the commonest mode of injury. The mean AAST grade was 2.55. The most common association was a left lung contusion (20%). Fifteen patients presented with shock among which two failed the protocol-based resuscitative efforts and were hence explored. One of the patients had lung contusion and the other dorsal vertebral fractures (3rd and 4th). Another patient with mesenteric tear and delayed hemorrhage was operated. Two other patients underwent surgical interventions for bowel perforation and fracture of right femur respectively. Spleen was preserved in both of these patients. Though, the NOM was successful in overall 87.5% patients, spleen specific success rate was 92.5%.
Conclusions: Application of protocol-based NOM in patients with BSI with OAI is highly successful if instituted in properly selected patients especially those with low grades of injury and also in those with delayed presentation.

Keywords: Non-operative management, Blunt splenic injury, Other associated injury

INTRODUCTION

During the world war II splenectomy was the consensus treatment for all splenic trauma patients.[1] In 1952 Schumacker reported a syndrome of "overwhelming post-splenectomy infection" (OPSI) which lead to the emergence of intraoperative splenic salvage procedures.[2] In the 1970s the pediatric surgeons in Toronto started non-operative management (NOM) of splenic injuries which later on became the standard of care for isolated blunt splenic injuries (BSI) with satisfactory success rates.[3] However, literature is scarce about the NOM of BSI with other associated injuries (OAI).[4]

The main aim of this study is to assess the applicability of protocol based NOM in BSI with OAI.

METHODS

This prospective study was conducted in Department of Pediatric Surgery, Sheri Kashmir Institute of Medical Sciences Srinagar Kashmir from March 2014 to March 2018. Patients ≤16 years of age who were brought to specialty with blunt abdominal trauma with splenic injury and OAI were included in the study. Patients with age >16 years, penetrating injuries and documented hollow viscus injuries were excluded from the study. After receiving the patients in emergency department (ED) resuscitative measures were immediately instituted with simultaneous clinical assessment. Primary survey (<5 minutes) was conducted to rule out any life or limb threatening injury. Focused assessment with sonography for trauma (FAST) was done in every patient for screening of intra-abdominal injuries and hemoperitoneum. Those patients with a positive FAST scan were subjected to CECT abdomen. American association for the surgery of trauma (AAST) organ injury scale was used for grading the splenic injuries. Trauma panel blood investigations were sent. Skeletal survey was performed which includes X-ray imaging of chest, cervical spine and pelvis in all patients of blunt trauma abdomen (BTA). Other imaging radiographs were done as and when required. Patients were managed according to a set protocol depicted in Figure 1. NOM was taken up in those patients who were hemodynamically stable or became stable after initial resuscitative measures. Conservative management was abandoned in patients who remained hemodynamically unstable or developed hemodynamic instability even after two fluid boluses (40 ml/kg) and >20 ml/kg of packed red blood cells (PRBC) transfusions. Requirement of more than 40 ml/kg of PRBC within 24 hours of admission also formed an indication of laparotomy. The lowest acceptable blood pressures for age (5th percentile) as described by the guidelines of pediatric advanced life support (PALS 2010) were taken as reference values. The data was collected and analyzed by SPSS.

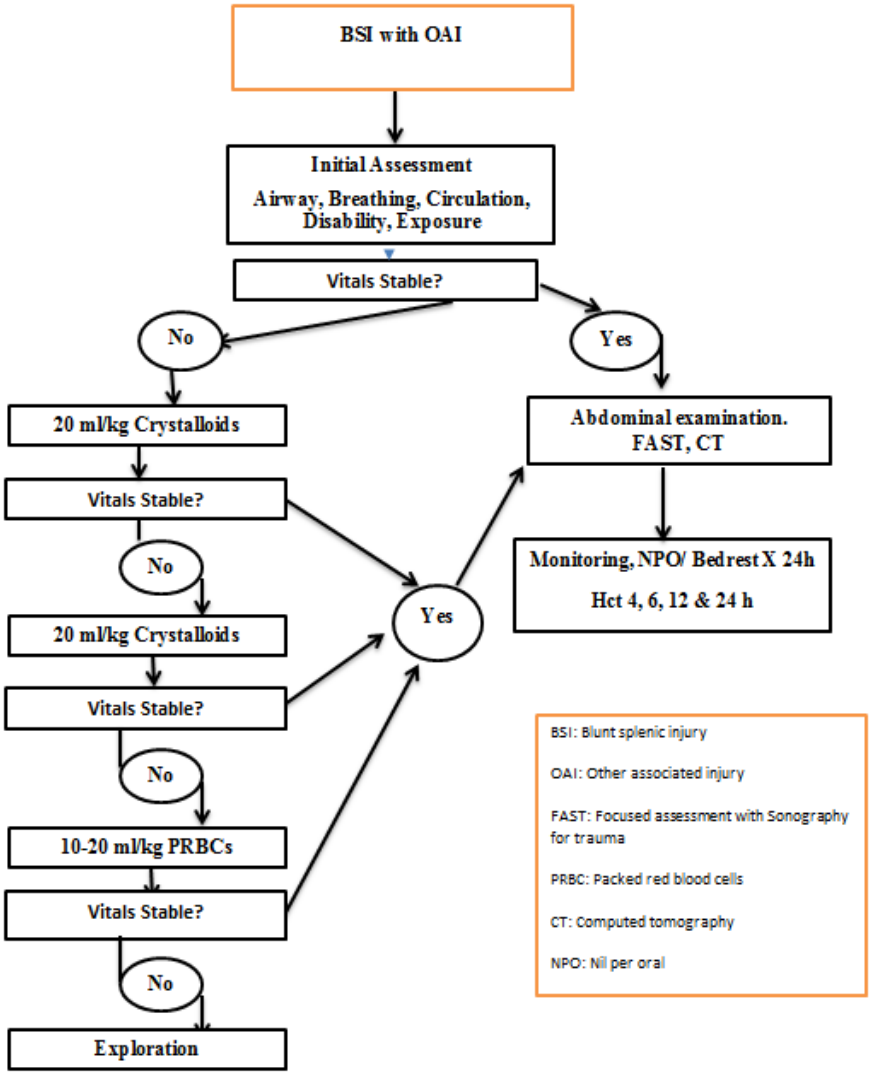

Figure 1: Patient management algorithm.

BSI: Blunt splenic injury; OAI: Other associated injury; FAST: Focused assessment with Sonography for trauma; PRBC: Packed red blood cells; CT: Computed tomography; NPO: Nil per oral.

RESULTS

Over the period of four years 40 patients with BSI with OAI were studied. The mean age of the patients was 7.05±3.9 years. There were 29 males and 11 females (male female ratio 2.6:1). The most common mode of trauma was falls from height (50%) followed by motor vehicle accident (40%). Sports injuries accounted for 7.5% and other injuries 2.5% (Table 1). The average time to reach the hospital was 4.1±3.1 hours. None of the patients reported to the emergency department (ED) during the first hour of injury. Maximum time taken to reach the ED was 9.2 hours. The mean AAST grade of splenic laceration was 2.55 (Table 2). OAI are detailed in Table 3. Four patients had more than two organ involvement. The most common association was a left lung contusion (20%). On presentation the average systolic blood pressure (SBP) was 74.1±6.1 and the average pulse rate was 87±13 per minute. Fifteen patients presented with hypotension (BP less than the 5th percentile for that age). Among these fifteen patients two failed the protocol-based resuscitative efforts and were hence explored. One of the patients had lung contusion and the other dorsal vertebral fractures (3rd and 4th) with AAST injury grades of IV and V respectively. Another patient with delayed hemorrhage had mesenteric tear and a huge hematoma, continued fall of hematocrit and borderline SBP and was hence operated. Two other patients underwent surgical interventions for bowel perforation and fracture of right femur respectively. Spleen was preserved in both of these patients. Though, the NOM was successful in overall 87.5% patients, spleen specific success rate was 92.5% as the two patients with bowel perforation and fracture femur each didn't undergo splenectomies. Eight (20%) patients received blood transfusions. Twelve patients required intensive care unit admissions. The average length of stay was 8.7±2.1 days. Average period till return to full activity was 7.5±1 week. Complications we observed were features of peritonism in one and subdiaphragmatic abscess in other, managed conservatively.

Table 1: Patient demographics.

Variables	
Mean age (years)	7.05±3.9
Males, N (%)	29 (72.5)
Females, N (%)	11 (27.5)
Fall from height, N (%)	20 (50)
Motor vehicle accident, N (%)	16 (40)
Sports injuries, N (%)	3 (7.5)
Other injuries (animal gores), N (%)	1 (2.5)
Average time to reach ED (hours)	4.1±3.1 (min 2.09 and max 9.2)
Mean grade of laceration	2.55
Average BP (mmHg)	74.1±6.1 (max 118, min 58)
Average pulse rate (per min)	87±13 (max 178, min 61)
Successful NOM, N (%)	35 (87.5)
Unsuccessful NOM, N (%)	5 (12.5)
Length of stay (days)	8.7±2.1
Return to full activity (weeks)	7.5±1

Table 2: AAST grades of blunt splenic injury.

AAST grades of splenic injury	Number of patients (%)
I	7 (17.5)
II	10 (25)
III	18 (45)
IV	4 (10)
V	1 (2.5)
Mean grade	2.55

Table 3: Injuries associated with blunt splenic injury.

Associated injuries	Number of patients (%)
Cranial bone fracture	2 (5)
Fracture of zygoma	2 (5)
Extradural hematoma	1 (2.5)
Lung contusion	8 (20)

Continued.

Associated injuries	Number of patients (%)
Hemothorax	4 (10)
Pneumothorax	4 (10)
Rib fracture	7 (17.5)
Fracture of pubic ramus	1 (2.5)
Supracondylar fracture	1 (2.5)
Fracture femur	1(2.5)
Fracture radius	3 (7.5)
Fracture ulna	1 (2.5)
Spinal injury	2 (5)
Liver injury	3 (7.5)
Kidney injury	2 (5)
Small bowel Injury	1 (2.5)
Mesenteric tear	1 (2.5)

DISCUSSION

Among the traumatic injuries, blunt trauma is the leading cause of intra-abdominal injuries in children with spleen being the most common solid organ to be injured.[5] Worldwide majority of BSI are sustained by motor vehicle accidents.[6] Contrary to this most of our patients received BSI due to falls (50%). Motor vehicle accidents accounted for 40% of injuries. Sports injuries and other modes of injuries were rare in our patient population. As seventy percent of our population lives in rural areas, road traffic accidents are expected to be less.[7] Falls from height are more common especially falls from apple and walnut trees.[8] The male to female ratio was 3.2:1 which is comparable to the observations made by other studies.[9] Male children are more likely to have traumatic injuries especially younger males with lack of parental supervision.[6] Our study revealed that the school going children (average age 7.05±3.9) were more vulnerable to BSI thus affirming the findings of Djordjevic et al who found that the maximum number of patients with abdominal trauma were seen in age group of 6-10 years.[9] The mean grade of splenic injury was 2.5, close to the grades reported by other authors.[10,11] Nevertheless, the grades of the injuries depend upon the mode and severity of the impact that a patient receives.

Hypotension was seen in 15 (37.5%) patients. Out of 15 patients 12 (80%) patients were successfully resuscitated as per the protocol. Two patients failed the resuscitative efforts and one more had a delayed hemorrhage. It has been seen by other studies that most of these patients respond adequately to the resuscitation.[12] Blood transfusion was required in 8 (20%) patients. Over the period of years transfusion rates which were initially around 60% decreased significantly with the NOM.[13] El-Matbouly et al reported a transfusion rate of 14.4% in isolated splenic trauma.[14]

Among the associated injuries chest injuries were seen in 23 (57%). Twelve patients received chest tube drainage. One patient had extradural hematoma (EDH) with preserved Glasgow coma scale/score (GCS) and no midline shift on computed tomography and was amenable to conservative treatment. Two patients needed surgical interventions other than splenectomy (small bowel injury n=1, fracture of right femur n=1). Three other patients needed exploration with splenectomy. One of the patients had lung contusion and the other dorsal vertebral fractures (3rd and 4th). Third patient with mesenteric tear developed delayed hemorrhage with hemodynamic instability. In concordance with our findings Jabbour et al observed similar distribution of concomitant injuries with predominantly lung injuries.[15] Most of these patients can be managed non-operatively if they are hemodynamically stable.[16] We observed a success rate of 87.5 % with protocol based NOM which rose to 92.7% if only spleen specific success rates were calculated. A success rate of 82% to 100% has been achieved with NOM of blunt splenic injury.[17] Mehall et al achieved a success rate of 100%.[10] We have previously reported a success rate of 100% for isolated BSI from our center.[11] However, for the patients with OAI we achieved an overall success rate of 87.5% with spleen specific success rate of 92.5% which is lesser than the previously reported one but is fairly good thereby implying that BSI with concomitant injuries can be successfully managed by application of NOM protocol. Nevertheless, NOM should only be considered in a scenario that provides capabilities for monitoring, serial clinical examinations, and an operating room available round the clock.[17] Patients presenting with hemodynamic instability and peritonitis still warrant emergent operative intervention.[17] NOM has also been extended to the management of multiple organ injuries. Previously it was thought that the multiplicity of the solid organ involvement is associated with the failure of NOM but now ample evidence is pouring out in favor of NOM of simultaneous multiple solid organ injuries.[4] It is worthwhile to note that following trauma the average time taken to report to ED was 4.1±3.1 hours. This delay in presentation is due to absence of integrated and organized emergency care systems especially in the developing world.[18] It has been observed that due to non-availability of basic care, 30% of deaths occur at the site of accident and 80% of remaining patients die in the first

hour after the injury, the golden hour, the time frame during which patients could have been saved had they reached the trauma center safely.[19] In other words the patients who reach the hospital beyond one hour of injury are relatively stable and are ideal candidates for NOM.[19] In our study none of the patients presented within 1st hour of injury which may be an indirect reason for high success rate of our NOM of BSI. Combined with the fact that most of the splenic injuries are low grade, 87.5% in our study, the results of NOM are expected to be high. To evaluate this strategy in high grade splenic trauma with OAI, we need a larger cohort of study population.

We didn't experience many complications barring features of peritonism in one patient with huge intra-abdominal hematoma which settled on 3rd day of admission and a subdiaphragmatic abscess which we encountered in one patient. Both of these complications are well known in literature and were managed conservatively.[20]

The average length of stay was 8.7±2.1 days. Average period till return to full activity was 7.5±1 week. Although we followed the American Pediatric Surgery Guidelines for length of stay (LOS) as well as for restriction of activity in our isolated BSI patients, there are no such guidelines for BSI with OAI and will be determined by type and severity of the associated injuries.

CONCLUSION

Non-operative management in patients of BSI with other associated injuries is highly successful with adoption of standardized treatment algorithm in properly selected patients especially those with low grades of injury and also in those with delayed presentation.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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